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CONCLUSIONS.

Oceanodroma leucorhoa occurs regularly in the tropical Atlantic from September to April or May. It has been taken on and south of the Equator in March and April. The range of the species should be restated in part as follows: — Breeds from southern Greenland and the Faeroes south to Maine and the Hebrides; south in migration to the Equator and the vicinity of Cape San Roque, Brazil.

SOME SUGGESTIONS FOR BETTER METHODS OF RECORDING AND STUDYING BIRD SONGS.

BY ARETAS A. SAUNDERS.

UP to the present time our methods of recording bird songs have been lacking in uniformity. We realize the fact that bird songs are a great help in field identification of species, when once learned. We admit that a knowledge of these songs is as much to be desired as a knowledge of plumage or migration, that it should occupy as prominent a place in the science of ornithology. But if we search through various writings for records of the song of a given species, we find a heterogeneous and uncertain mixture of data that do not give us any satisfactory impression of the song. Various methods have been used to describe and record bird songs, but so far, only one method, that of musical notation, has been possessed of any scientific accuracy.

Musical notation, as a method of recording bird songs, has been subject to a great deal of adverse criticism. It has been made primarily for the recording and rendering of human music and birds do not usually sing according to such standards. The musical scale gives no place for the recording of notes that are slightly sharp or flat. Its standards of time do not allow the record of a song that does not follow the rhythmic beat of its measures. Do

birds sing in any given key? Do they recognize any fundamental notes? Can one beat time to a bird's song? In the majority of cases these questions must be answered in the negative. Only a few individuals of certain species approach these standards of music. The great majority of birds sing in a free, non-mechanical, natural manner that cannot be recorded on the musical scale with the exactness that it deserves. If we have no better method we must resort to musical notation, but if we can find a better method, one which discards the mechanical rules of human music, without losing any of its scientific accuracy, we can take a long step in advance toward the true scientific study of bird song.

Before discussing the possibilities of such a method, it is first essential to have a definite classification of the points concerning which we desire information to make our knowledge of a given song complete. These points appear to me to be five in number. They are pitch, duration, intensity, pronunciation and quality. Concerning quality I have no suggestions to offer farther than those already made by others. Sound qualities are baffling and difficult to describe with accuracy, and, until we can have a definite and practical classification of them, they will continue to be so.

Our records of pitch, duration and intensity must be first comparative, for the different notes or parts of a given song, and second absolute, for a comparison of the song with other songs of the same or another species. A pitch pipe, together with a good musical ear, are necessary to obtain the comparative and absolute pitch in the field. A stop watch is probably the best instrument with which to get records of duration. Comparative intensity can be recorded with reasonable accuracy by ear, but absolute intensity is more difficult to measure. The intensity of a song must necessarily vary with the weather conditions, the temperature, the pressure of the air, and above all the direction and velocity of the wind. We know, however, that the intensity of sound varies inversely as the square of the distance from its source, and this gives us something tangible to go by. If then, our bird will remain in one spot singing, on a day when there is no wind, while we find the farthest point at which the softest and loudest parts of its song are audible, we will have a definite measure of intensity. This process seems destined to try to the utmost the patience and perseverance of the future student of bird song.

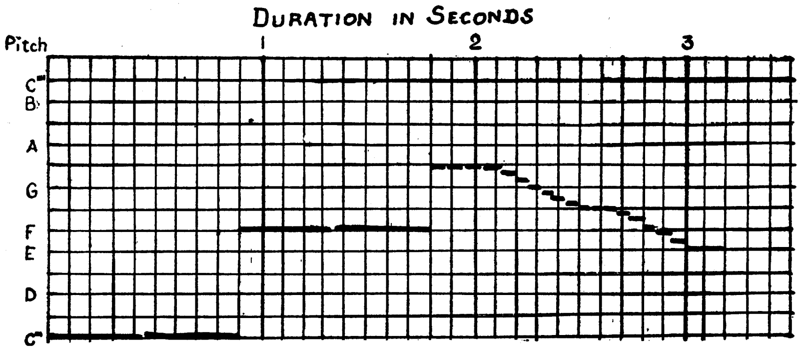

Fig. 1. Song of the Vesper Sparrow. West Haven, Conn., April 23, 1914, 6 A. M.

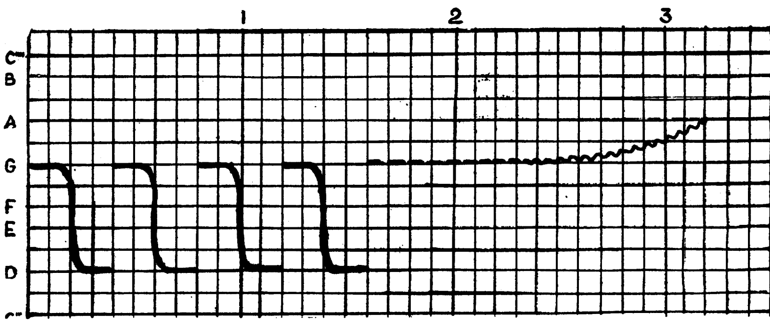

Fig. 2. Song of the Field Sparrow. West Haven, Conn., April 18, 1914, 9 A. M.

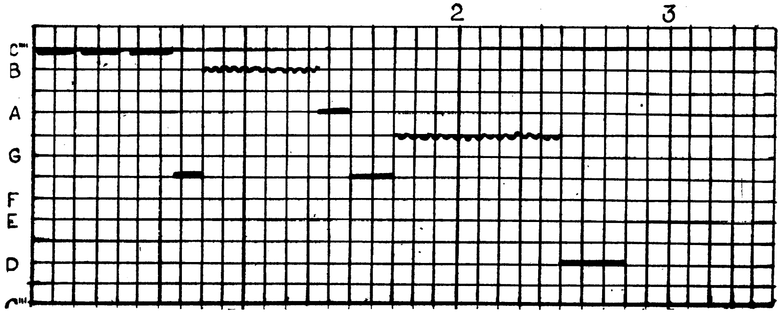

Fig. 3. Song of the Song Sparrow. Gunhill Road, N. Y. City, April 3, 1914, 9.15 A. M.

The following method has occurred to me by which the pitch and duration of a song may be represented graphically, when once it is determined. This method is to represent the song by lines on ordinary coördinate paper, plotting the pitch along the ordinate, that is in a vertical direction, and the duration along the abcissa in a horizontal direction. In order to see whether this method was practical, I tested it in the field during the spring of 1914, recording 104 different songs and call-notes, representing 18 different species. The species included both birds with simple songs, such as the Junco and Phœbe, and others with more complicated songs such as the Song Sparrow (fig. 3) and Purple Finch (fig. 4). It also included some bird sounds not properly classed as songs, such as certain call-notes of the Flicker and the scream of the Red-shouldered Hawk.

Of course this method is not without its difficulties. It is usually impossible, even with the simplest songs, to record them after one hearing only, and with a long continued song, it is only possible to catch and record phrases here and there. Such difficulties, however, would be just as great, or even greater in using musical notation. I have tried several times to record bird songs by musical notation, and am certain that this graphic method is much simpler, and much more easily used and mastered than is the other. In the matter of pitch, one does not have to ascertain whether the bird is singing in three flats, five sharps or something else. If the bird flats a little, or uses an interval not strictly a fifth, seventh, or some other known to human music, this fact may be shown and need not be modified to fit the human standard. In the matter of time the same things are true. Notes need not be reduced to quarters and eighths when they really have no such definite relations to each other, but may be represented in their actual true duration. In short, the method, like the bird's song itself, is natural, and does not follow any fixed rule of either pitch or time.

The unit of measurement of pitch is of course the octave, but this is not divided into eight parts as on the musical scale, but into twelve parts, representing the twelve half-tones. Thus B and C, and E and F are shown in their true relations, half a tone apart, and not, as on the musical scale, spaced the same distance apart as

notes that are separated by a whole tone. The unit of time is not the measure, further modified by the addition of adagios, allegros or numbers signifying beats per minute, but is the second, a unit that is uniform and unchanging, and thoroughly understood both by musicians and by the uninitiated. The second may be further divided into fifths, the smallest unit that can be recorded by an ordinary stop watch. I have found that in practise it is still better to divide it into tenths, so that short, rapidly repeated notes may be easily represented, and lengths of songs may be expressed in decimals.

In putting this method into practise, I have found a few modifications from the definite rules necessary in order to record the characters of all songs clearly. A rest, or pause in a song would of course be represented by a break in the horizontal continuity of the lines representing it. Many bird songs, particularly those of the sparrows, contain series of short, rapidly repeated notes all on the same pitch, without a pause between them. If the method were rigidly adhered to, these would be represented by a continuous straight line, and the separate notes could not be distinguished. In order to avoid this I have written such songs with a slight break in the horizontal lines to keep the distinct notes separate, although there is really no pause in the song. When such notes become so rapid that the number cannot be counted, the note becomes a trill. I have represented trills by continuous, slightly wavy lines, the wave not representing any variation in pitch, but the pitch of the note being recorded by the central axis of the wavy line. These conditions are shown in the illustrations of songs of the Song and Field Sparrows.

The illustrations will suffice to make more clear the graphic method of recording songs. I have used the letters C′, C″, C‴, etc., to indicate middle C and the octaves above it. Where notes on different pitches are slurred together, I have represented this fact by connecting them by an almost vertical line. Such slurs are characteristic of the Meadowlark's song (fig. 7) and are also found in the introductory notes of the Field Sparrow record (fig. 2). One criticism of my method that has been made is that all notes are not connected by these vertical lines, to give the songs more continuity of appearance. This would make it diffi-

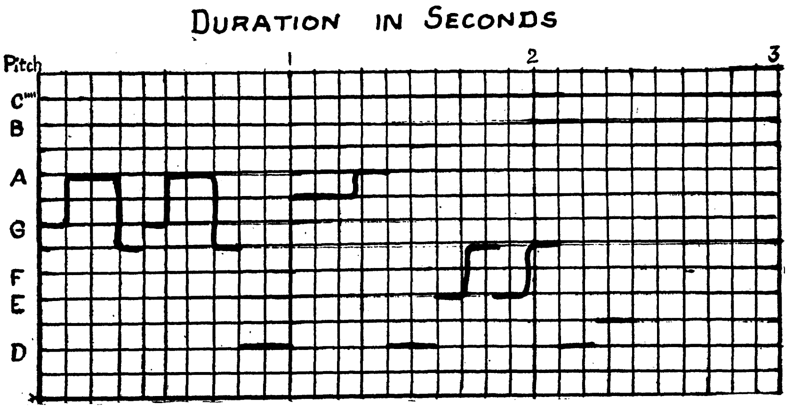

Fig. 4. Song of the Purple Finch. West Haven, Conn., April 28, 1914, 5.30 P. M.

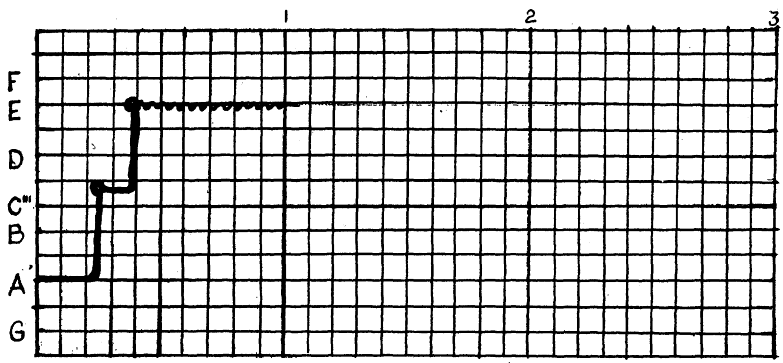

Fig. 5. Song of the Red-winged Blackbird. Gunhill Road, New York City, April 3, 1914, 8.30 A. M.

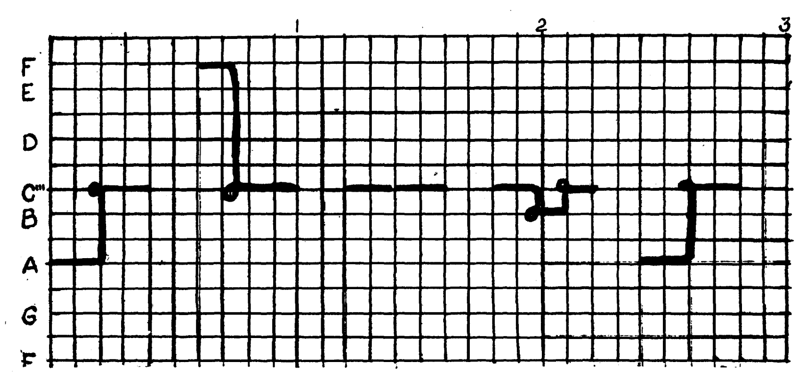

Fig. 6. Song of the Robin. West Haven, Conn., April 17, 1914, 5.30 P. M.

cult to distinguish between notes that are slurred together by the bird and those that are clearly separate. This difficulty is at best a slight one. The disconnected appearance of the songs may seem great at first glance, but becomes insignificant as one becomes accustomed to the method.

By this same method it is also possible to represent the variations in intensity of a bird song. This could be done by variation in the breadth or heaviness of the lines, making heavy lines for the loud notes, and light lines for the softer ones. I have not yet attempted to measure the intensity of bird songs in the field so have omitted this factor from the illustrations.

The factor of pronunciation is one that presents some difficulties. To just what extent birds produce recognizable vowel or consonant sounds in their songs it is hard to say. It is probably true that a purely musical note has no real vowel sound and that the only difference in such notes is that of quality and not pronunciation. Consonant sounds, however, may be occasionally recognized in bird songs and call notes. The "k" sound in the call note of the crow, for instance, is universally recognized. In true songs I believe that the explosive consonants, such as "p," "k," "t" etc., are rare. The commonest consonant sounds are liquid ones, such as "l" and "r", connecting different notes. In the songs I have studied and recorded, the liquid "l" is the only consonant I have recognized. This sound is quite common in the songs of many species and is evidently an important distinguishing character. I have represented the presence of this sound by a loop, at the beginning of the note introduced by it, as shown in the songs of the Robin (fig. 6) and Redwinged Blackbird (fig. 5).

One of the first things that one notes after studying songs for a time in the field is that even the simplest and commonest songs are tremendously variable. This variation extends not only to different individuals, but also to different songs by the same individual. The song of the Meadowlark is one that is quite simple and easy to record, and yet shows enough variation to make a very interesting study (fig. 7). I have recorded thirty different songs of the Meadowlark by the graphic method, and believe that with time and opportunity I could record three or four times as many. Seven of these songs were sung by the same bird during an hour's time.

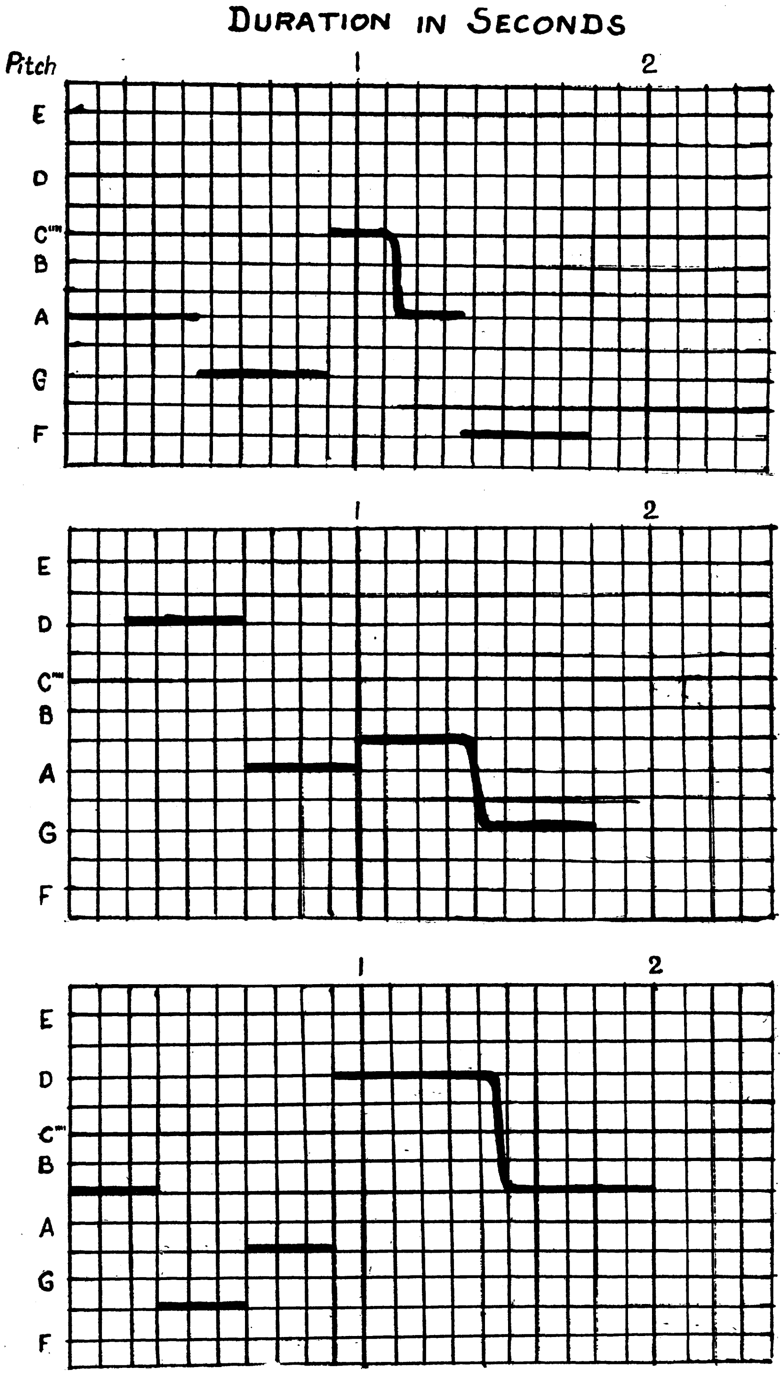

Fig. 7. Three Songs of the Meadowlark. No. 1. West Haven, Conn., October 18, 1914, 3 P. M. No. 2. Mt. Vernon, N. Y., April 7, 1914, 5 P. M. No. 3. West Haven, Conn., April 21, 1914, 5.30 A. M.

The song of the Song Sparrow is even more variable. Not only does each individual have two or more totally different songs, but I have yet to find two individuals whose songs are at all alike. It seems probable that the number of variations of the Song Sparrow's song is greater than the number of individual Song Sparrows.

Since the variations in the song of a single species are so great, a question arises as to what are the factors in which these variations resemble each other. The songs of both the Meadowlark and the Song Sparrow, except in unusual instances, are easily recognized in the field. What characters then are specific? Quality undoubtedly is one. But quality is not the only one, for songs of different species may often have the same quality and yet be easily distinguished. To determine the others it becomes necessary to record a large number of songs of the same species. By comparison of these the points of similarity may be determined, and the amount of variation to which the song is subject may be shown.

I have not yet recorded enough songs of any one species to make a complete study of the song of that species, or to make any statements concerning it that are general in application. As an illustration of how this may be done, however, I have figured out some results from twenty-seven records of the Song Sparrow's song that are interesting though not conclusive. The longest duration of any of these songs is 3.2 seconds, the shortest 1.8 seconds. The average duration is 2.79 seconds. The highest note in any record is D'''' and the lowest D'', giving a range for the species of two octaves. The greatest range of any one song is twelve half-tones or exactly one octave. The least range is four half-tones. The average range is 8.7 half-tones. All but one of the songs contain one or more trilled notes, and this one contains a series of rapidly repeated notes on the same pitch, differing from a trill only in the fact that the single notes are distinct and slow enough to be counted. This arrangement of notes is also a common character and occurs in fourteen of the songs. Most of the songs begin in a more or less characteristic manner and two such types of beginning are recognizable. The first of these consists of three notes on the same pitch varying from two to three tenths of a second in length. Twelve of the songs, including the one in the illustration show this type of beginning. The second consists of one or two long notes,

followed by four to six rapidly repeated ones, all on the same pitch. Seven of the songs have this type of beginning. The remaining eight songs are irregular and show no definite types. None of the songs show enough similarity in termination to draw any general conclusions.

In this manner, from a large number of records of a single species, one should be able to draw fairly definite conclusions concerning the song even when it is extremely variable. Many other interesting facts concerning bird songs may be deduced by studying and recording them in the field. Thus two Field Sparrows, singing alternately and within hearing of each other, produced songs that were exactly alike in every respect, while two Song Sparrows singing under similar conditions had songs that were dissimilar except for the last three notes which were exactly alike.

Field work in studying and recording bird songs is more or less difficult according to the qualities of the person attempting the work. A good musical ear is absolutely essential. Records made by a person not possessed of such an ear for music would be of no more value than descriptions of plumages made by one who is color blind. A knowledge of music is essential also, but it need not be great. In fact I believe that very little musical knowledge is necessary to use or understand the graphic method of recording songs.

In the absence of a stop watch it is possible to use an ordinary watch provided it is a good one, though its use is more difficult. An ordinary, good watch ticks five times to the second, so that fifths of a second may be measured by listening to the ticks. In making records of songs in the field it is of value to record the date, locality and time of day with the record. These points may serve to show important facts concerning the variation of songs due to these factors.

It is also possible to add the factor of quality to the record by writing a statement of this at the top of the record, as suggested by Mr. Robert T. Moore in his paper on musical notation at the A. O. U. meeting of 1913. I have not done this on my records as I feel that the statements would be too inexact to be of much value. All of the songs I have used in illustration are to my mind of a whistled quality, and I am of the opinion that the differences in

them are largely, if not wholly due to pitch, intensity or the presence of liquid consonants.

Thus, all five of the factors, pitch, duration, intensity, pronunciation and quality, may be recorded on a single sheet by this graphic method. The results, I believe, will be intelligible to musicians, and a little less "like Greek" to those whose knowledge of written music is slight.

LIST OF THE BIRDS OF LOUISIANA. PART VII.

BY H. H. KOPMAN.

(*Concluded from p. 29.*)

247. WESTERN TANAGER (*Piranga ludoviciana*). The only known record of the occurrence of this bird in Louisiana is a specimen taken on March 19, 1898, by Mr. Andrew Allison in Jefferson parish, on the opposite bank of the Mississippi river from New Orleans. It was a parti-colored male, with yellow predominating.

248. SCARLET TANAGER (*Piranga erythromelas*). This bird is seldom very common in Louisiana except for a few days at a time. It is most apt to occur at New Orleans about April 20 and in the early part of October. The earliest date of arrival at the latitude of New Orleans is April 8, 1900, at Bay St. Louis, Miss., and the latest date in spring is May 9, 1903, at Lobdell, La. Considerable waves are sometimes present the latter part of April, and about Oct. 10, 1896, I saw an unusual number in the suburbs of New Orleans. The latest date of departure is Oct. 20, 1897, at Ariel, Miss.

249. SUMMER TANAGER (*Piranga rubra rubra*). Common summer visitor, especially in the higher sections of the State. In the swampy region in the southeastern part it shows a disposition to frequent particular neighborhoods, especially those which are better drained. The earliest date of arrival in the latitude of New Orleans is March 31, 1902, at Bay St. Louis, Miss. The latest date of departure is Oct. 27, 1899 and 1900, at Covington, La. It is sometimes remarkably abundant at New Orleans during waves in the latter part of April and early part of October.

250. PURPLE MARTIN (*Progne subis subis*). Common summer visitor, arriving usually about Feb. 15, becoming common about March 10, and disappearing more or less completely from the southern part of the State about Sept. 15. A large southward flight is usually noted at the Gulf